CS/ECE 252: INTRODUCTION TO COMPUTER ENGINEERING
COMPUTER SCIENCES DEPARTMENT
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Midterm Examination 1
In Class (50 minutes)
Monday, October 1, 2007
Weight: 15%

CLOSED BOOK, NOTE, CALCULATOR, PHONE, & COMPUTER.

The exam has **four** two-sided pages.

Plan your time carefully, since some problems are longer than others.

NAME: _____

SECTION: _____

ID# _____

Problem Number	Maximum Points	Graded By
1	4	EH
2	3	EH
3	3	NEJ
4	4	NEJ
5	4	SR
6	4	SJ
7	4	GJ
8	4	SJ/SR/NEJ
Total	30	

Problem 1 (4 points)

a) What is the largest (most positive) integer that can be represented as an *unsigned* integer using 13 bits?

$1111111111111_b = (2^{13} - 1)_d = 8191_d$

Full credit for any one of $(2^{13} - 1)_d$ or 8191_d

b) What is the largest (most positive) integer that can be represented as a *two's complement* integer using 13 bits?

$0111111111111_b = (2^{12} - 1)_d = 4095_d$

Full credit for any one of $(2^{12} - 1)_d$ or 4095_d

Problem 2 (3 points)

Consider bitwise logical operations: Compute **(1101 AND 0111) OR (NOT 0011)**

(1101 AND 0111) OR (NOT 0011) = (0101) OR (1100) = 1101

Problem 3 (3 points)

Convert the number **-84** (base ten) into two's complement representation with 8 bits.

$$+84_d = 01010100_b$$
$$-84_d = 10101011_b + 1_b = 10101100_b$$

Problem 4 (4 points)

Consider the 8-bit binary bit pattern **10010010**. What is its decimal (base ten) value if the bit pattern is interpreted as:

a) An unsigned integer?

$$10010010_b = 128 + 16 + 2 = 146_d$$

b) A two's complement integer?

$$10010010_b = -(01101101 + 1)_b = -(01101110)_b = -(64 + 32 + 8 + 4 + 2)_d = -110_d$$

Problem 5 (4 points)

a) Add the following 5-bit two's complement binary numbers: `01111 + 01101`. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

11100 - There is overflow.

b) Add the following 5-bit two's complement binary numbers: `11110 + 01111`. Express your answer in 5-bit two's complement. Please indicate if there was an overflow.

01101 - There is no overflow.

Problem 6 (4 points)

a) Convert the ASCII string "`F4n`" into binary. (See attached ASCII table. Only convert the characters between the quotation marks.)

"F4n" = 0x46347E = 01000110 00110100 01111110 (00000000 at end OK)

b) Convert the binary value `0010010001101011` into an ASCII string.

0010010001101011 = 0x246B = "$k"

Problem 7 (4 points)

a) What is the base ten (decimal) value represented by binary `110.101` ?

$110.101 \quad = 1 \times (2^2) + 1 \times (2^1) + 0 \times (2^0) + 1 \times (2^{-1}) + 0 \times (2^{-2}) + 1 \times (2^{-3})$
$= 4 + 2 + 0 + 1/2 + 0 + 1/8$
$= 6\ 5/8$ (or 53/8, 6.625, etc.)

b) The bits for an IEEE floating point number are allocated as follows:

sign (1 bit)	exponent (8 bits)	fraction (23 bits)

where $N = (-1)^S \times 1.\text{fraction} \times 2^{\text{exponent}-127}$

Convert `1 10000001 11000000000000000000000` to decimal.

$N = (-1)^1 \times (1.11)_b \times 2^{129-127} = -1 \times (1.11)_b \times 2^2 = -(111)_b = -7$

Problem 8 – Circle the correct answer (2 points each)

I. Which of the following is a universal computing device?
   a. A 16-button(0-9, period, =/+/-/x/÷) calculator
   b. A laptop computer running Windows XP
   c. An ultrafast supercomputer
   d. All of the above
   e. Both (b) and (c)

II. When referring to an algorithm, definiteness means:
   a. **Each step must be precisely defined**
   b. The algorithm's variables must not overflow a fixed number of bits
   c. The number of unknowns and equations is the same
   d. None of the above

ASCII Table

Character	Hex	Character	Hex	Character	Hex	Character	Hex
nul	00	sp	20	@	40	`	60
soh	01	!	21	A	41	a	61
stx	02	"	22	B	42	b	62
etx	03	#	23	C	43	c	63
eot	04	$	24	D	44	d	64
enq	05	%	25	E	45	e	65
ack	06	&	26	F	46	f	66
bel	07	'	27	G	47	g	67
bs	08	(	28	H	48	h	68
ht	09	)	29	I	49	i	69
lf	0A	*	2A	J	4A	j	6A
vt	0B	+	2B	K	4B	k	6B
ff	0C	,	2C	L	4C	l	6C
cr	0D	-	2D	M	4D	m	6D
so	0E	.	2E	N	4E	n	6E
si	0F	/	2F	O	4F	o	6F
dle	10	0	30	P	50	p	70
dc1	11	1	31	Q	51	q	71
dc2	12	2	32	R	52	r	72
dc3	13	3	33	S	53	s	73
dc4	14	4	34	T	54	t	74
nak	15	5	35	U	55	u	75
syn	16	6	36	V	56	v	76
etb	17	7	37	W	57	w	77
can	18	8	38	X	58	x	78
em	19	9	39	Y	59	y	79
sub	1A	:	3A	Z	5A	z	7A
esc	1B	;	3B	[	5B	{	7B
fs	1C	<	3C	\	5C			7C
gs	1D	=	3D	]	5D	}	7D
rs	1E	>	3E	^	5E	~	7E
us	1F	?	3F	_	5F	del	7F

Scratch Sheet (in case you need additional space for some of your answers)